1991 CALGARY REGIONAL TRANSPORTATION MODEL PRIMER

THE CITY OF CALGARY
LAND USE AND MOBILITY
PLANNING AND TRANSPORTATION POLICY
FORCASTING AND TRANSPORTATION DATA

104-02882/

1991 Calgary Regional Transportation Model Primer

The purpose of this report is to provide an overview of the City of Calgary's Transportation Model. The City uses this model in a wide variety of applications in Transportation Planning.

The 1991 Calgary Transportation Model is an a.m. peak hour model incorporating road and transit networks. The model is implemented using the emme/2 system.

1. Zone System

   The zone system covers the current city boundaries, and areas that may be developed in long term planning horizons. Although some zones may be vacant, or nearly vacant, in 1991, the extension beyond the city boundaries provides for a consistent zoning system through all forecasting horizons. The number of zones has increased from 175 in 1981 to 387 in 1991. This increased number reflects both the larger area covered and the finer level of detail. Figure 1 shows a map of the 1991 zone system.

2. Auto Network

   The auto network was coded in more detail in 1991 than in previous models with the intention of improving model accuracy. This meant including most collector roads in the network and making more extensive use of emme/2's capability of modelling turn delays at intersections. Figure 2 shows the auto network used in 1991.

   New link volume delay functions were introduced. New categories based on posted speed and traffic control were developed for the link volume delay functions. The new functions incorporate over capacity delays that correspond to over capacity delays estimated by the Canadian Capacity Guide for Signalized Intersections. New categories were also introduced for turn delay functions. Figure 3 shows the turn delay locations. A special set of turn delay functions was used to specify 'bottleneck' delays. Figure 4 shows the special bottleneck delay locations.

3. Transit Network

   The transit network incorporated into the 1991 model is shown in Figure 5.

4. Definition of a.m. Peak Hour

   The objective in defining the a.m. peak hour was to strike a balance between a model that is simple and accurate and a model that is useful. An a.m. peak hour dominated by Home to Work trips is simpler and more accurate. An a.m. peak hour of 7:16 to 8:15 based on the midpoint time of the trip was selected.

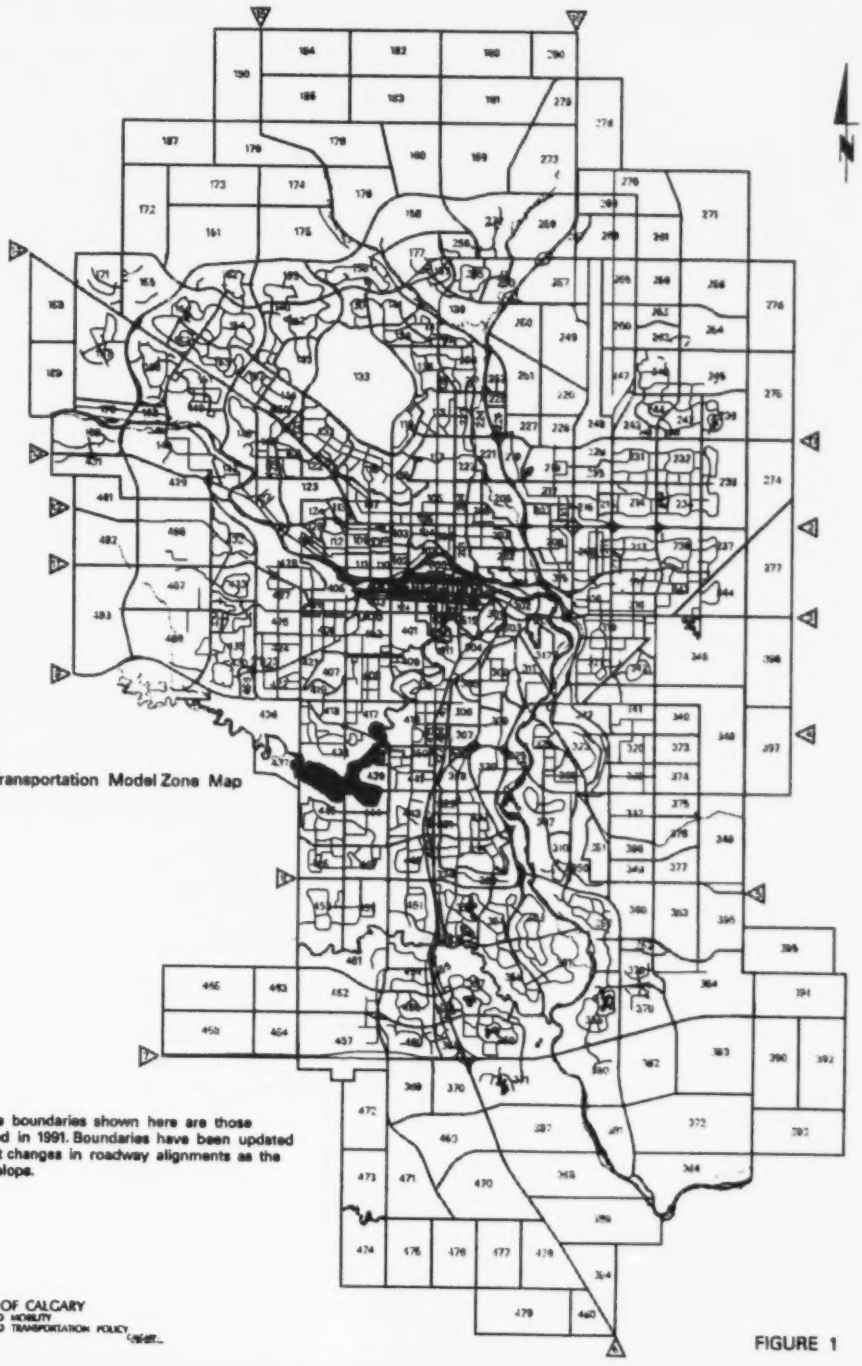

FIGURE 1
1991 Calgary Transportation Model Zone Map

NOTE: The zone boundaries shown here are those developed in 1991. Boundaries have been updated to reflect changes in roadway alignments as the city develops.

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FIGURE 1

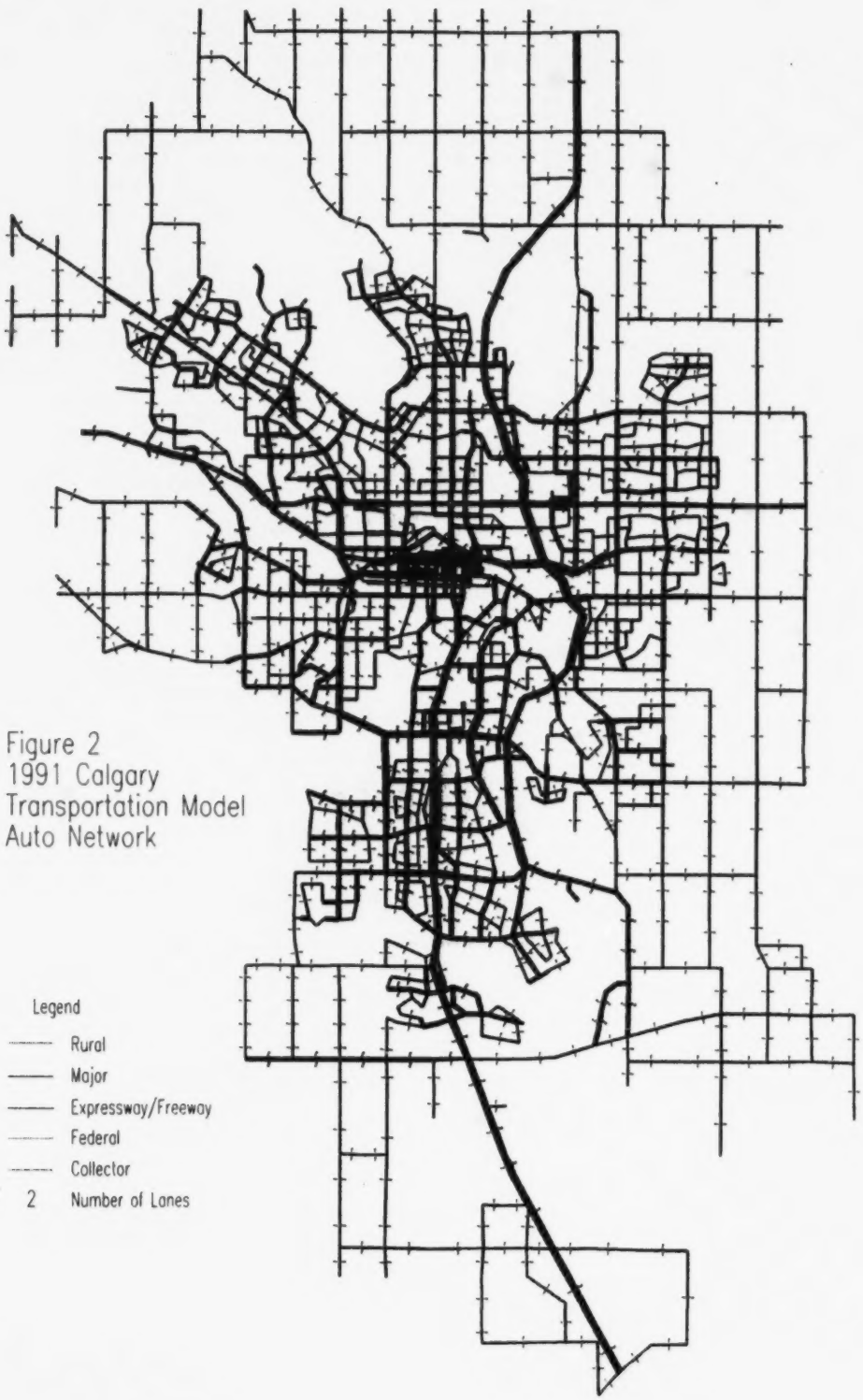

Figure 2
1991 Calgary
Transportation Model
Auto Network

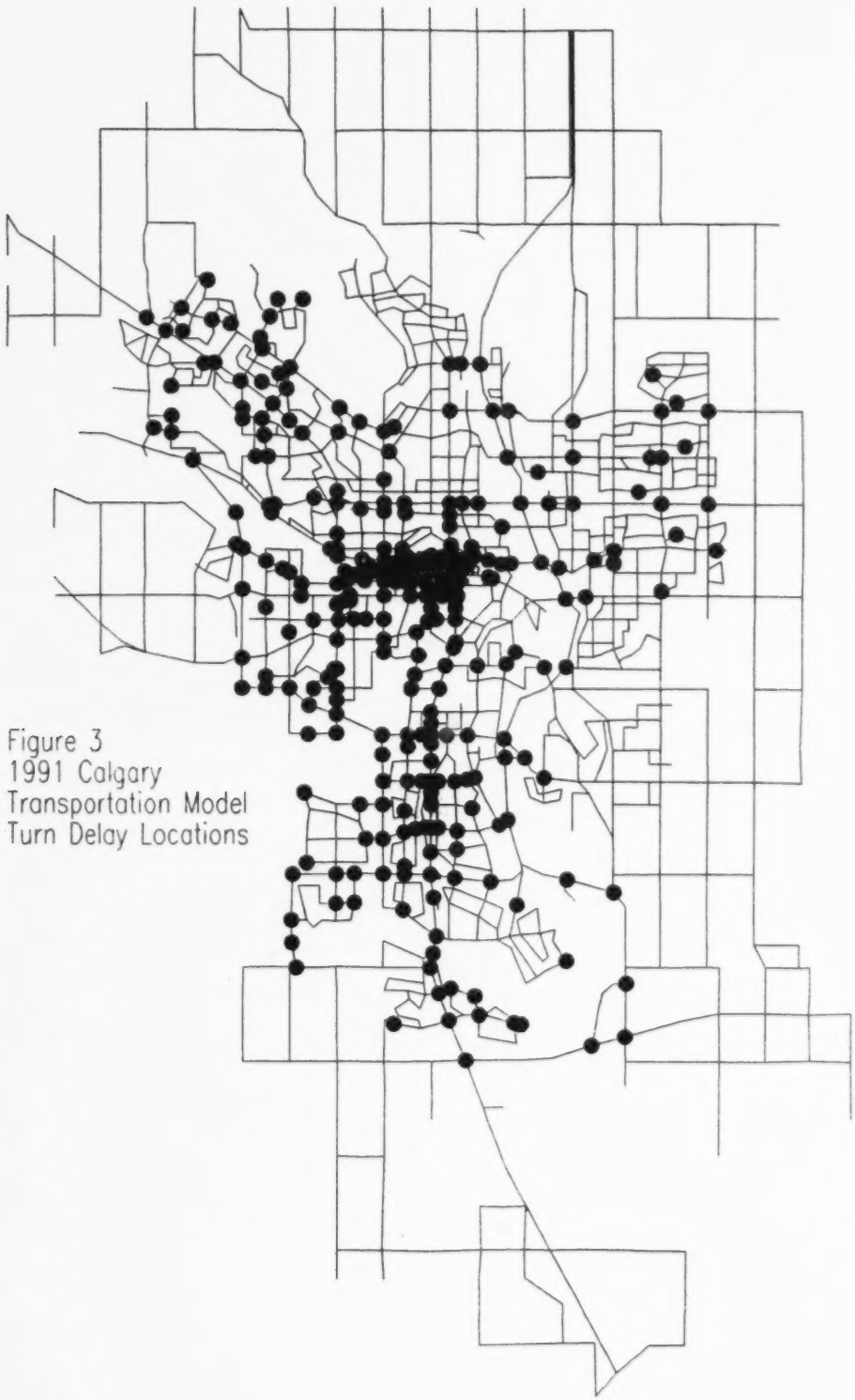

Figure 3
1991 Calgary
Transportation Model
Turn Delay Locations

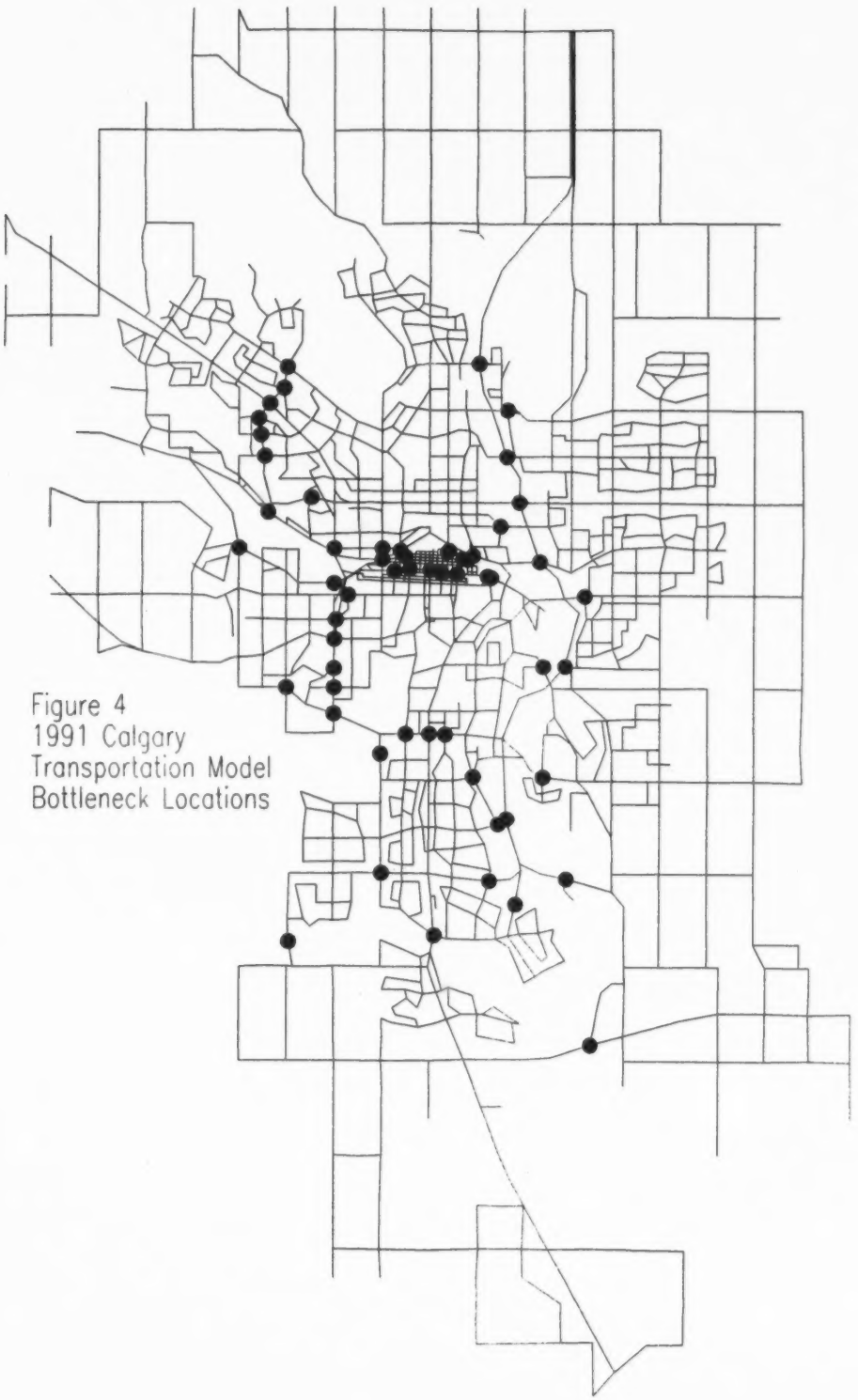

Figure 4
1991 Calgary
Transportation Model
Bottleneck Locations

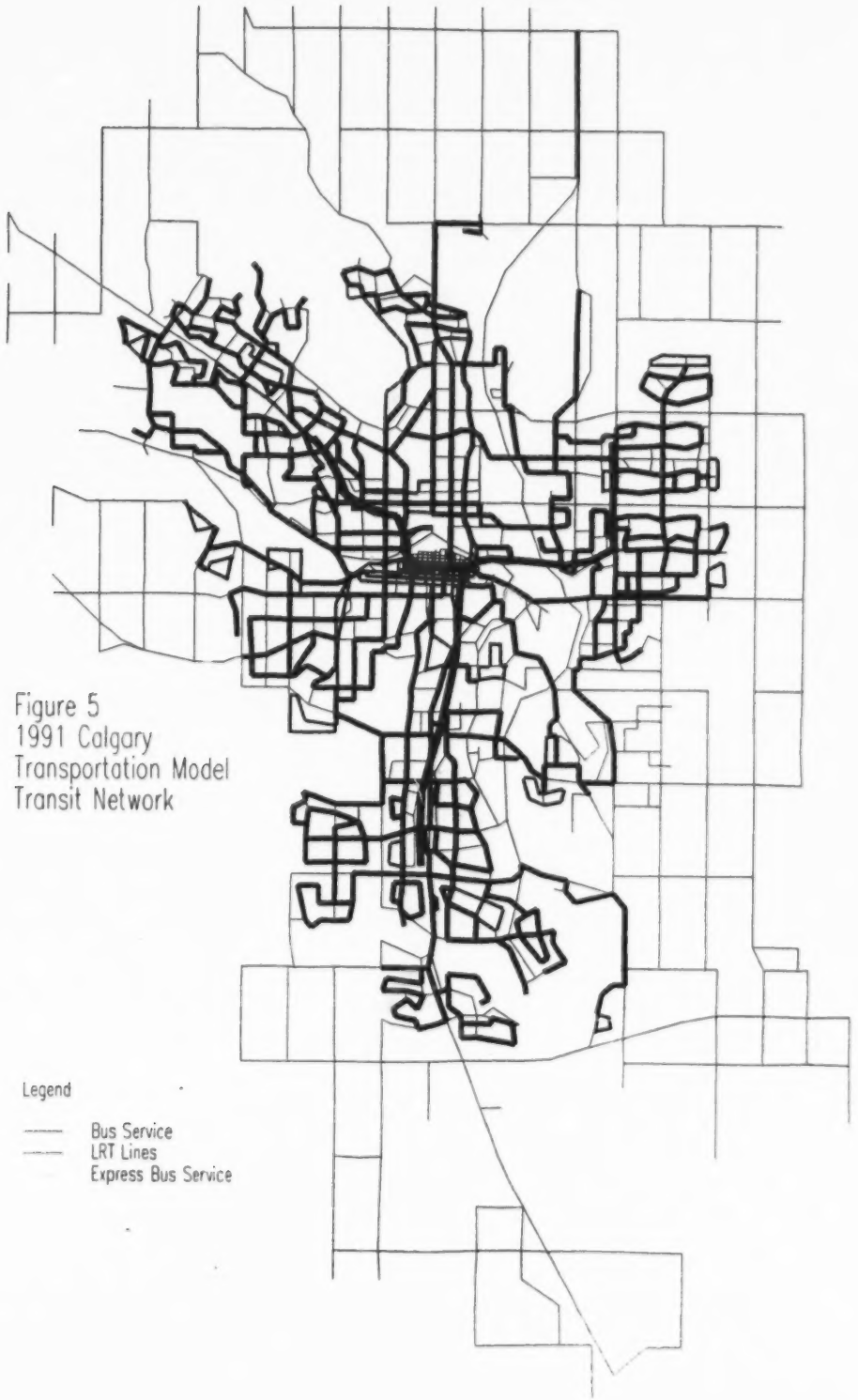

Figure 5
1991 Calgary
Transportation Model
Transit Network

5. Definition of Trip Purposes and Modes

Table 1 shows a summary of trips by mode and purpose prepared and used for the discussion of the model structure. Some Home to Work trips are coded in the survey as two trips, a trip from home to an intermediate stop, then a trip from the intermediate stop to work. Many of these trips were converted into Home to Work trips using a process called trip linking. This is illustrated in Figure 6. This simplified development of the model, at the cost of some model accuracy. Fewer than 5% of trips were affected by trip linking.

Figure 6: Trip Linking

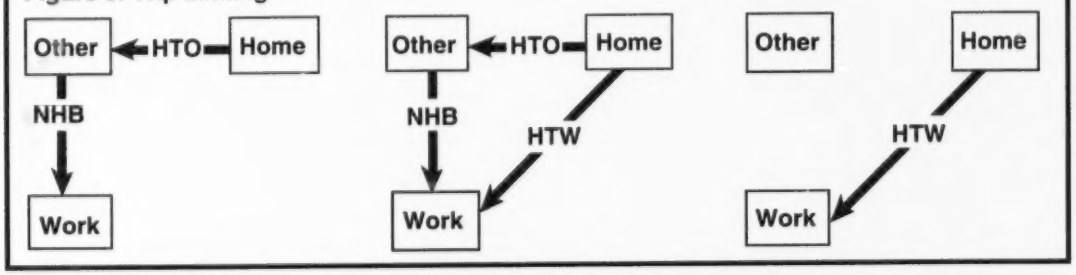

Table 1: Number of Trips by Trip Type - 1991 Travel Survey - a.m. Peak Hour

Type of Trip	Mode of Travel				
	Auto Driver	Transit Pass.	Auto Pass.	Other	Total
Home to School (Grade 1 to 6)	0 (0.0%)	488 (8.6%)	2,311 (40.6%)	2,895 (50.8%)	5,694 (2.9%)
Home to School (Grade 7 to 12)	711 (3.7%)	9,483 (49.3%)	3,932 (20.5%)	5,094 (26.5%)	19,218 (9.8%)
Home to School (Post Secondary)	3,605 (42.8%)	3,558 (42.2%)	1,224 (14.5%)	44 (0.5%)	8,431 (4.3%)
Home to Normal Work	56,471 (65.1%)	16,894 (19.5%)	8,113 (9.4%)	5,311 (6.1%)	86,788 (44.4%)
Home to Other Work	7,989 (81.4%)	650 (6.6%)	770 (7.8%)	407 (4.2%)	9,817 (5.0%)
Home to Serve Passenger to Other	16,322 (83.3%)	117 (0.6%)	3,158 (16.1%)	0 (0.0%)	19,596 (10.0%)
Home to Serve Passenger to Normal Work	10,237 (85.5%)	682 (5.7%)	978 (8.2%)	72 (0.6%)	11,969 (6.1%)
Home to Serve Passenger to Other Work	991 (83.6%)	46 (3.9%)	136 (11.4%)	12 (1.0%)	1,185 (0.6%)
Home to Personal Business to Other	3,293 (72.9%)	364 (8.0%)	825 (18.3%)	36 (0.8%)	4,518 (2.3%)
Home to Personal Business to Normal Work	581 (62.0%)	189 (20.1%)	67 (7.1%)	101 (10.8%)	937 (0.5%)
Home to Personal Business to Other Work	96 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	96 (0.0%)
Home to Other	1,260 (15.4%)	194 (2.4%)	6,614 (81.0%)	91 (1.1%)	8,159 (4.1%)
Work to Work (NHB)	4,761 (86.0%)	52 (0.9%)	427 (7.7%)	293 (5.3%)	5,533 (2.8%)
Other to Other (NHB)	5,022 (65.7%)	173 (2.3%)	2,072 (27.1%)	374 (4.9%)	7,641 (3.9%)
Other to Home	5,030 (85.2%)	132 (2.2%)	730 (12.4%)	14 (0.2%)	5,905 (3.0%)
External to Internal	NA				
Total	116,366 (59.5%)	33,021 (16.9%)	31,356 (16.0%)	14,744 (7.5%)	195,487 (100.0%)

The model incorporates seven trip purposes. These are:

5.1 Home to Work (HTW)

These are trips originating at home and destined for work. It includes Home to Normal Work, Home to Other Work and the Home to Work trips created in trip linking. Trip generation uses the zonal category approach. Trip distribution uses a gravity model incorporating composite utility (combining the mode utilities for all modes from the logit model) with K-factors. Congested travel times are used to calculate the mode utilities. A logit modal split model is used to calculate trips by six different modes: auto one-person, auto two-person, auto three-person, transit, walk and bicycle. This allows the model to forecast vehicle occupancy.

5.2 Post Secondary Education (PSE)

This purpose consists of trips to SAIT, the University of Calgary and Mount Royal College. Trips to other post secondary schools (such as the Alberta Vocational College and commercial schools) which are included under post secondary in Table 1 are included in Home to Other in the model. Trip generation uses a zonal category model similar to the Home to Work model. Trip distribution uses a gravity model incorporating composite utility (combining the mode utilities for auto and transit from the logit model) with K-factors. Congested travel times are used to calculate the mode utilities. A logit modal split model is used to calculate auto person and transit passenger trips. Auto occupancy is estimated using a normative model.

5.3 Home to Other (HTO)

This purpose consists of trips from home that are not explicitly included in other trip purposes. This includes the Home to Serve Passenger, Home to Personal Business and Home to Other categories in Table 1. Trips to other post secondary schools (such as the Alberta Vocational College and commercial schools) that had been included in home to post secondary in Table 1 are included in Home to Other in the model. Trip generation uses a zonal category model similar to the Home to Work model. Trip distribution uses a gravity model incorporating composite utility (combining the mode utilities for auto and transit from the logit model). Congested travel times are used to calculate the mode utilities. A logit modal split model is used to calculate auto person and transit passenger trips. Auto occupancy is estimated using a normative model.

5.4 Non Home Based (NHB)

This purpose consists of trips that do not start or end at home. This includes the Work to Work and Other to Other trips in Table 1. It also includes the Serve Passenger to Work and Personal Business to Work trips that were not eliminated in the trip linking. Trip generation uses a zonal category model similar to the Home to Work model. Trip distribution uses a gravity model incorporating composite utility (combining the mode utilities for auto, transit and metabolic from the Home to Work logit model). Congested travel times are used to calculate the mode utilities. A normative modal split model is used to calculate auto person and transit passenger trips. Auto occupancy is estimated using a normative model.

5.5 Home to School 1-12 (SCH)

This trip purpose was included in the model to obtain a more reasonable estimate of Calgary Transit ridership. Only trips by Calgary Transit destined to elementary, junior high and senior high schools were included. Trips by other modes or to other types of schools were not modelled. Trip generation uses a zonal category model similar to the Home to Work model. Trip distribution uses a gravity model incorporating congested auto travel times. A trip end normative modal split model is used to estimate transit passenger trips.

5.6 Other to Home (OTH)

The Other to Home trips include any trips that have a destination of home. The model estimates the Other to Home trip table by transposing and factoring the Home to Work and Home to Other trip tables. The model uses a normative modal split model to estimate auto drivers. The remaining trips, including transit passenger trips, are treated as auto passenger trips.

5.7 External (EXT)

External trips are trips made by people living outside the City limits. The 1991 external trip table was estimated by factoring the 1981 observed external trip table.

Table 2 shows the breakdown by trip purpose and mode of the observed trips from the Household Travel Survey and the 1981 External Cordon Survey. Trips that are modelled explicitly are highlighted in bold font.

Table 2: Trip Purpose by Mode

Trip Purpose	Auto Driver	Auto Pass.	Transit Pass.	Metabolic (walk and bicycle)	Other	Total
Home to Work	**73,812**	**9,587**	**17,575**	**5,499**	218	106,694 (53.6%)
Home to PSE	**3,649**	**1,127**	**2,580**	NA	31	7,387 (3.7%)
Non Home Based	**19,080**	**3,791**	**1,137**	NA	1,086	25,094 (12.6%)
Home to Other	**11,929**	**9,508**	**1,607**	NA	141	23,185 (11.7%)
Other to Home	**5,030**	**730**	**132(1)**	NA	13	5,905 (3.0%)
School 1 - 12	784	6,696	**9,774**	NA	8,197	25,451 (12.8%)
External	**5,230**	NA	NA	NA	NA	5,230 (2.6%)
Total	119,514	31,439	32,808	5,499	9,686	198,946 (100.0%)

Note(1): Other to Home transit passenger trips are treated as auto passenger trips in the model.

6. Auto Assignment

The model uses the emme/2 auto fixed demand assignment procedure. The assignment set the maximum number of iterations to 200, the relative gap to 0.5% and the normalized gap to 0.

7. Transit Assignment

The model uses the emme/2 transit assignment procedure. emme/2 controls the assignment by assigning different weights to different components of the travel time. The ride time was assigned a weight of 1, while the walk and wait times were assigned a weight of 2. Unrealistic transfers were controlled by using a boarding time at each node. This time could vary from zero to 20 minutes depending on the location.

8. Trip Table Estimates

Since the model estimates the modal split and trip distribution based on congested times the model must be iterated to produce a better approximation of the equilibrium conditions. The iteration was continued until the normalized mean absolute error between subsequent auto trip table estimates was less than 4%. This was selected based on tests of the model using different stopping criteria. Little improvement in accuracy was found when smaller criteria were used.